Survey of Apple Juice Packed in 1947

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IN the 1946 apple juice survey[3] conducted by the National Apple Institute in cooperation with the Eastern Regional Research Laboratory, it was observed that the quality of juice was lower than in the previous surveys of 1940[4] and 1941.[5] No definite relationships could be established between the flavor scores and such factors as the variety of apples used, type of container, or method of processing.

In conjunction with the 1946 survey[3] the effect of storage temperature on four pairs of laboratory-prepared samples was studied. Samples stored for 7 months at 75° F. averaged two points lower than those stored for the same period at 35° F. From these results, it appears that proper storage conditions are an important factor in preserving the delicate apple flavor of processed juice.

A similar storage experiment was conducted on a larger scale with the 1947 commercial pack of apple juice. As before, the survey did not include the pulpy type of juice or that sold without processing. Each packer was invited to participate by submitting a case of freshly packed apple juice at the peak of the season. As in previous surveys along with this invitation was included a questionnaire on the history of the sample submitted.

On arrival, the samples were placed in storage at 35° F. until the initial flavor test was made early in January. At that time several containers from each were placed in storage at 75° F., the remainder staying in cold storage. Five months later both sets of samples were scored for flavor.

Twenty-eight packers submitted 32 samples; 7 were from New England and New York, 6 from the Appalachian area, 9 from the North Central region, 5 from the Pacific coast, and 1 from Canada.

Typical apple flavor should be the most important criterion in scoring apple juice. The laboratory taste panel of 25 persons scored all the samples for flavor alone on the 10-1 scale, which is defined as: 10-9, excellent; 8-7, good; 6-5, fair; 4-3, poor; and 2-1, objectionable. Two standards, preserved by freezing, and rated 7 and 3, respectively, were used for comparison in all tests.

Table 1 gives the flavor scores as well as complete production and analytical data for this survey. Table 2 lists the code numbers to apple varieties used.

The flavor scores averaged 5 in the initial test; after 5 months' storage at 35° F. and 75° F. the average scores were 5 and 4, respectively.

The nationwide picture of apple juice quality is disappointing. In the previous surveys the juice was about 6 months old when tested, but in 1947 it was the freshly packed juice that was used. Table 3 gives average flavor scores for all the surveys and for nine samples in each survey. Six of the 9 samples packed in 1947 had scores below the average for the four years. Of course, seasonal differences and lack of a reliable standard juice for use in tests from year to year may be responsible for differences between various years. It is somewhat encouraging to note that although sample 8 falls below its average score in 1947, it still ranks among the high quality samples.

Fourteen out of 22 juices have improved since 1946; however, it was expected that the 1947 samples would be higher in quality since they were only one month old instead of seven.

The storage tests showed a slightly greater loss of flavor after 5 months at 75° F. than at 35° F. The loss of flavor was greater in the better quality juices and almost negligible in the poorer juices. The correlation by rank between the original scores and the losses during high temperature storage was highly significant. In other words, the higher the original quality the more necessary it is to protect this quality by low storage temperature. Conversely, if the juice is poor in the beginning, it can't become much worse even if stored at a high temperature.

Table 4 classifies the samples into groups by flavor scores. At the initial scoring, 63 per cent of the samples rated 5 or above. After 5 months' storage at room temperature, only 50 per cent rated 5 or 6, and none scored above 6.

Table 5 gives the relationships of the various factors to the initial flavor score.

Fifteen packers used glass containers, 12 used enameled

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[3] "Survey of Apple Juice Packed in 1946," Margaret E. Heller, Truman Nold, and J. J. Willaman. Eastern Regional Research Laboratory, United States Department of Agriculture, Bureau of Agricultural and Industrial Chemistry AIC-161. September 1947. (Processed).

[4] "Survey of Apple Juice Packed in 1940," H. H. Mottern, Truman Nold, and J. J. Willaman. FRUIT PROD. J. 21, No. 3, 68-71 (1941).

[5] "Survey of Apple Juice Packed in 1941," H. H. Mottern, Truman Nold, and J. S. Hudnut. Eastern Regional Research Laboratory, United States Department of Agriculture, Bureau of Agricultural and Industrial Chemistry ACE-186. [1942] (Processed.)

Table 1

Data on Apple Juice Samples Submitted in 1947 Survey

Code No.	Container[1]	Varieties used[2]	Storage of Apples	Treatment Before Pasteurization[3]	Clarity	Sediment	Degrees Brix	pH	Acidity as Malic Acid %	Typical Apple Flavor Score[4] Initial	After 5 mo. storage at- 35° F.	75° F.
3	G	17, 29	common	HP	clear	0	12.8	3.9	0.46	5	6	6
3A	G	17, 29	common	C	cloudy	+	12.5	3.8	0.47	5	5	5
7	M	1, 9, 11, 16	fresh	none	hazy	+	10.6	3.7	0.58	3	2	2
8	G	1, 5, 9, 11 21, 22, 25, 30	cold common	C	cloudy	0	13.5	3.8	0.54	7	7	6
18	G	1, 14, 16	fresh	C	clear	0	13.8	3.8	0.51	7	6	5
22	M(e)	1, 5, 11, 16	common, fresh	HB	clear	0	12.4	3.2	0.67	6	6	6
27	M	1, 14	fresh	DF	hazy	0	12.2	3.4	0.57	5	5	4
36	G	4,12,14,28	cold	C	cloudy	+	11.0	3.3	0.56	4	4	4
44	G	6	fresh	P	clear	0	13.4	3.6	0.39	4	4	4
44A	G	5,17,20,21,29	fresh	P	clear	0	14.4	3.6	0.42	6	6	5
46	G	3, 5, 17	common	DF	clear	0	14.5	3.4	0.39	6	6	6
51	M(e)	5,11,14,16,28	common	DF	hazy	0	12.4	3.3	0.44	7	7	6
59	G	5, 29	cold	P	clear	0	12.5	3.4	0.52	4	5	5
60	G	27	fresh	P	clear	0	16.4	3.7	0.40	4	4	4
62	M	1,7,13,14 16,24	common and fresh	DF	hazy	0	12.4	3.4	0.52	6	5	5
63	G	4,5,7,14,24	fresh	HB	clear	0	12.8	3.4	0.54	6	6	5
63A	M(e)	same	fresh	HB	clear	0	12.2	3.3	0.66	4	5	4
68	M(e)	15, 19, 25	fresh	GT	clear	0	13.1	3.5	0.47	2	3	2
71	M(e)	5, 8, 11, 16	--	P	clear	0	14.1	3.5	0.57	5	5	4
77	G	1, 21, 25	cold	P	clear	0	12.3	3.5	0.51	6	7	6
84	G	1, 7	fresh	GT	clear	0	12.4	3.4	0.61	5	5	4
94	G	29, 30	fresh	C	cloudy	0	11.3	3.5	0.46	5	5	5
98	M(e)	1,7,8,9,10,23	common	H	hazy	0	12.6	3.2	0.49	6	5	4
109	M	1,5,14,16	cold,common	DF	cloudy	++	12.6	3.3	0.57	3	1	1
109A	M(e)	1,5,14,16	cold,common	DF	cloudy	++	13.2	3.3	0.70	6	1	1
113	M(e)	5,11,21,25,30	fresh	C	cloudy	++	13.8	3.5	0.52	7	7	6
117	M(e)	1,2,4,14,16	cold,common	HP	clear	0	12.1	3.3	0.51	4	4	4
142	M(e)	11,14,16,17, 18,26	common	HB	clear	0	11.9	3.4	0.51	6	6	5
146	G	1,7,14,16	common	HP	clear	0	12.3	3.4	0.53	6	7	6
183	M	1, 14	cold,common	P	hazy	0	11.8	3.3	0.59	3	3	3
184	M(e)	14, 31	fresh,common	GT	clear	+	12.8	3.4	0.72	4	4	4
184A	M(e)	14, 31	fresh,common	GT	clear	0	12.0	3.5	0.65	4	4	4
Average							12.8	3.5	0.53	5.1	4.9	4.3

1/ G = Glass
M = Plain metal
M(e) = Enameled Metal

2/ See Table 2 for code

3/ DF = Direct Filtration
C = Centrifuge
P = Pectinol
HB = Heat coagulation and bentonite
HP = Heat coagulation and pectinol
GT = Gelatin tannin

4/ 10-9 = Excellent
8-7 = Good
6-5 = Fair
4-3 = Poor
2-1 = Objectionable

Table 2

Code to Varieties

Code No.	Variety	Number of samples
1	Baldwin	13
2	Ben Davis	1
3	Bellflower	1
4	Cortland	3
5	Delicious	10
6	Gravenstein	1
7	Greening	5
8	Grimes Golden	2
9	Golden Delicious	3
10	Hubbardston	1
11	Jonathan	7
12	King David	1
13	Maiden Blush	1
14	McIntosh	11
15	Nero	1
16	Northern Spy	10
17	Newton-Pippin	3
18	Ontario	1
19	Paragon	1
20	Ranier	1
21	Rome Beauty	4
22	Smokehouse	1
23	Stark	1
24	Snow	2
25	Stayman	4
26	Steele's Red	1
27	White Pearmain	1
28	Wealthy	2
29	Winesap	3
30	York Imperial	3
31	Fameuse	1

Table 3

Flavor Scores of Nine Juices Represented in Four Surveys

Code No.	Flavor Score in- 1940[1]	1941[1]	1946	1947	Average
3	8	6	4	5	5.7
8	10	8	6	7	7.7
18	4	4	4	7	4.7
46	6	6	8	6	6.3
51	6	4	5	7	5.3
63A	6	8	5	4	5.7
71	6	6	4	5	5.3
77	6	4	3	6	4.7
84	8	6	6	5	6.3
Average score	6.6	5.8	5.0	5.8	
Total number of samples	54	47	36	32	
Average score	6.3	5.6	4.3	5.1	

The 5-1 scale used in 1940 and 1941 has been doubled to correspond with scores of 1946 and 1947.

Table 4

Effect of Storage on the Distribution of Flavor Scores

Flavor scale	Number of samples Initial test	After 5 months' storage at- 35° F.	75° F.
10-9, excellent	0	0	0
8-7, good	4	5	0
6-5, fair	16	16	16
4-3, poor	11	8	12
2-1, objectionable	1	3	4

Table 5
Relationship of Various Factors to Initial Flavor Score

	Number of samples having score of-						Total number of samples	Average
	7	6	5	4	3	2		
Container								
Glass	3	5	4	4	0	0	15	5.4
Enameled metal	1	4	1	4	0	1	12	4.9
Plain metal	0	1	1	0	3	0	5	4.0
Storage of Apples								
Cold	0	1	0	2	0	0	3	4.7
Common	1	4	2	0	0	0	7	5.9
Freshly harvested	2	2	3	3	1	1	12	4.8
Cold and common	1	1	1	1	2	0	5	4.6
Fresh and common	0	2	0	2	0	0	4	5.0
Not stated	0	0	1	0	0	0	1	--
Treatment before pasteurization								
Centrifuge	3	0	2	1	0	0	6	5.8
Direct filtration	1	3	1	0	1	0	6	5.5
Pectinol	0	2	1	3	1	0	7	4.6
Gelatin-tannin	0	0	1	2	0	1	4	3.8
Heat	0	1	0	0	0	0	1	--
Heat and bentonite	0	3	0	1	0	0	4	5.5
Heat and pectinol	0	1	1	1	0	0	3	5.0
None	0	0	0	0	1	0	1	--
Acidity as malic								
Less than 0.4%	0	1	0	1	0	0	2	5.0
0.4 to 0.6%	4	7	6	5	3	1	26	5.1
More than 0.6%	0	2	0	2	0	0	4	5.0
Degrees Brix								
Less than 13.0	1	7	5	6	3	0	22	4.9
13.0 and above	5	3	1	2	0	1	12	5.4
Added ascorbic acid	2	1	2	0	1	0	6	5.5

metal, and 5 used plain metal. Samples packed in glass averaged 6.4 originally, 5.5 when stored at 35° F., and 5.1 when stored at 75° F. In enameled metal, the average flavor scores were 4.9, 4.8, and 4.2, respectively; in plain metal they were 4.0, 3.2, and 3.0. Based on these samples, glass containers seem to be better than enameled metal, and plain metal containers are definitely inferior.

No relationship between flavor score and the type of storage for the apples can be determined. Obviously, type of storage does not tell the complete story—the condition of the apples when used is the important relationship. In past questionnaires, all processors stated that they used "good" apples; no mention was made of bruised, immature, overripe, or even rotten apples, which may have been used in some cases.

Rapid methods of processing seem to produce higher flavor scores. However, there were too few examples of each method represented to draw valid conclusions.

No correlation can be made between original flavor score and acidity as percent malic acid.

Brix values, however, show a definite relationship to flavor score; the samples having a Brix of 13° or more averaged 0.5 point higher in flavor score than those under 13°. A significant correlation by rank is shown between the original flavor score and the Brix value. A low Brix value, however, does not necessarily cause a poor flavor score. Of the 14 samples with flavor scores of 6 or above, 8 were below 13° Brix, 6 were below 12.5°, and 1 actually was less than 12.0°. A Brix of 12.5° is the minimum requirement for AMS U. S. Fancy Grade Apple Juice.

The effect of added ascorbic acid on stability of flavor during storage is not shown clearly by these data. Ascorbic acid had been added to samples 3A, 8, 94, 109, 109A, and 113 in amounts ranging from 10 to 50 mg. per 100 cc.; 3A, 8, 94, and 113 were fairly stable; 109 and 109A were most unstable. When no ascorbic acid was added, it was present in amounts for 0.4 to 4.4 mg. per 100 cc.

Improvement of Apple Juice

THERE is much room for improvement in the quality of commercial apple juice. The main items which affect quality are: (1) raw materials, (2) plant sanitation, (3) processing techniques, and (4) labeling and storage temperatures.

Raw materials should consist of sound, fully ripened fruit. A blend of sweet and astringent varieties having a minimum Brix of 12°, but preferably 13°, and an acidity between 0.4 and 0.6 percent malic acid is most desirable. Careful handling to avoid unnecessary bruising and adequate inspection to remove all bruises and rots are essential in order to prevent fermented off-flavors.

Poor sanitary conditions may cause sour and fermented off-flavors. The recommended procedure is to steam press cloths and boards at least twice daily and to clean all tanks and equipment at least once daily.

The choice of processing techniques is less important. In general, methods that require the least time between pressing and pasteurizing produce higher quality apple juice.

More careful attention should be paid to labeling and storage temperatures. Juice should be cooled to at least 100° F. and air spaces between stacks of cartons should be allowed for more rapid cooling. High quality juice can be ruined by cooked flavors, which develop after only a few days' storage at excessive temperatures.

Summary

TWENTY-EIGHT packers submitted 32 samples of freshly packed apple juice for flavor and storage tests. The samples were received early in the season, analyzed, and judged for flavor in January, and again after 5 months' storage at 35° F. and 75° F. A taste panel of 25 persons scored the juices for flavor alone on a 10-1 scale (10 being best).

The average flavor score was 5 for the initial test, 5 after 5 months' storage at 35° F., and 4 after storage for 5 months at 75° F.

Only the higher quality samples showed marked differences in flavor after the 5 months' storage period at 35° F. and 75° F.

Samples packed in glass were slightly better than those packed in enameled metal and far superior to those packed in plain tin.

Rapid processing procedures gave better flavored apple juice than those requiring more time.

The correlation by rank of the original flavor score and the Brix value was very significant.

No correlation was found between the original flavor score and the malic acid content.

A significant correlation by rank was found between the original flavor score and the difference between flavor scores of juices stored at 35° F. and 75° F.